

What is claimed is:

- 1 **1.** A secure communication system comprising:
2 a plurality of geographic cells, each cell being
3 associated with a specific geographic area and
4 having a cell cryptographic key for secure
5 communications with devices located within the
6 cell; and
7 a key management center that determines an
8 anticipated cell path of a mobile device from a
9 current cell to a destination cell and
10 distributes to the mobile device a set of
11 cryptographic keys necessary to permit secure
12 communications for the mobile device within each
13 cell along the anticipated cell path.
- 1 **2.** A system according to claim 1, further comprising:
2 a hierarchical tree having a root node, a plurality
3 of internal nodes, and a plurality of terminal
4 leaf nodes, the root node and each internal node
5 having an associated node cryptographic key for
6 secure communication with lower nodes in the
7 tree, each leaf node being associated with a
8 specific geographic cell.
- 1 **3.** A system according to claim 2, wherein the
2 cryptographic key of each node below the root node is
3 derived by applying a mathematical function to the
4 cryptographic key of the next higher level node.

1 4. A system according to claim 2 wherein the mobile device
2 knows the cryptographic key of each node in the tree on a
3 direct path back to the root node.

1 5. A system according to claim 2, wherein at least one
2 hierarchical level of the tree uses a structure of at
3 least three dimensions to connect to nodes in the next
4 lower hierarchical level.

1 6. A system according to claim 1, wherein the set of
2 cryptographic keys distributed to the mobile device
3 includes keys that are valid for a restricted period of
4 time based on the anticipated cell path.

1 7. A system according to claim 1, wherein the set of
2 cryptographic keys contains the minimum number of keys
3 necessary to permit secure communications for the mobile
4 device within each cell along the anticipated cell path,
5 but no other cells.

1 8. A method of secure communication comprising:
2 providing a plurality of geographic cells, each cell
3 being associated with a specific geographic area
4 and having a cell cryptographic key for secure
5 communications with devices located within the
6 cell;
7 determining an anticipated cell path of a mobile
8 device from a current cell to a destination
9 cell; and
10 distributing to the mobile device a set of
11 cryptographic keys necessary to permit secure

12 communications for the mobile device within each
13 cell along the anticipated cell path.

1 **9.** A method according to claim 8, further comprising:
2 arranging a hierarchical tree having a root node, a
3 plurality of internal nodes, and a plurality of
4 terminal leaf nodes, the root node and each
5 internal node having an associated node
6 cryptographic key for secure communication with
7 lower nodes in the tree, each leaf node being
8 associated with a specific geographic cell.

1 **10.** A method according to claim 9, wherein the
2 cryptographic key of each node below the root node is
3 derived by applying a mathematical function to the
4 cryptographic key of the next higher level node.

1 **11.** A method according to claim 9, wherein the mobile
2 device knows the cryptographic key of each node in the
3 tree on a direct path back to the root node.

1 **12.** A method according to claim 9, wherein at least one
2 hierarchical level of the tree uses a structure of at
3 least three dimensions to connect to nodes in the next
4 lower hierarchical level.

1 **13.** A method according to claim 8, wherein the set of
2 cryptographic keys distributed to the mobile device
3 includes keys that are valid for a restricted period of
4 time based on the anticipated cell path.

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1 14. A method according to claim 8, wherein the set of
2 cryptographic keys contains the minimum number of keys
3 necessary to permit secure communications for the mobile
4 device within each cell along the anticipated cell path,
5 but no other cells.

1 15. A computer program product for use on a computer system
2 for secure communication in a computer network, the
3 computer program product comprising a computer usable
4 medium having computer readable program code thereon, the
5 computer readable program code comprising:

6 program code for providing a plurality of geographic
7 cells, each cell being associated with a
8 specific geographic area and having a cell
9 cryptographic key for secure communications with
10 devices located within the cell;
11 program code for determining an anticipated cell path
12 of a mobile device from a current cell to a
13 destination cell; and
14 program code for distributing to the mobile device a
15 set of cryptographic keys necessary to permit
16 secure communications with the mobile device
17 within each cell along the anticipated cell
18 path.

1 16. A computer program product according to claim 15,
2 further comprising:
3 program code for arranging a hierarchical tree having
4 a root node, a plurality of internal nodes, and
5 a plurality of terminal leaf nodes, the root
6 node and each internal node in the tree having

7 an associated node cryptographic key for secure
8 communication with lower nodes in the tree, each
9 leaf node being associated with a specific
10 geographic cell.

1 17. A computer program product according to claim 16,
2 wherein at least one hierarchical level of the tree uses a
3 structure of at least three dimensions to connect to nodes
4 in the next lower hierarchical level.

1 18. A computer program product according to claim 17,
2 wherein the at least one hierarchical level is the level
3 in the tree immediately above the leaf nodes.

1 19. A computer program product according to claim 15,
2 wherein the set of cryptographic keys distributed to the
3 mobile device includes keys that are valid for a
4 restricted period of time based on the anticipated cell
5 path.

1 20. A computer program product according to claim 15,
2 wherein the set of cryptographic keys contains the minimum
3 number of keys necessary to permit secure communications
4 for the mobile device within each cell along the
5 anticipated cell path, but no other cells.